Research Article

Association between anthropometric indices and infertility among subfertile women: Insights from a single-centre cross-sectional study from Northern Sri Lanka

R Sivalingarajah[a], M Kopalasuntharan[b], K Thirunavukarasu[c], S Abirame[d], T Kavirajan[e]

Abstract

***Background*:** Obesity is a global concern affecting female fertility, with 6% of never-pregnant women facing fertility challenges due to obesity. This study aims to assess the association between Anthropometric Indices and Infertility Among Sub-fertile Women.

Methodology: This hospital-based cross-sectional study included 216 infertile women aged 18 years and above attending sub-fertility clinics at Teaching Hospital, Jaffna. Data collection consisted of an interviewer-administered questionnaire, anthropometric measurements, and statistical analysis using SPSS Version 26. Body Mass Index (BMI) was categorised according to Sri Lankan Obesity standards, and Waist-Hip Ratio (WHR) according to Asian women's standards.

Results: In our study, 72.2% had primary sub-fertility, and 27.8% had secondary sub-fertility. The average age was 33.7 years (SD=7.12), with 38.9% of them older than 35 years, and 56.9% of them seeking therapy within five years of marriage, while 43.1% delayed treatment. Age and sub-fertility types showed a positive association (P=0.003). The majority (70.3%) were overweight, pre-obese, or obese, with 66.7% at risk based on WHR. Primary sub-fertility cases had a higher prevalence of Polycystic Ovary Syndrome (PCOS). There were no significant differences in BMI between individuals with PCOS (M=26.473, SD=5.58) and those without PCOS (M=25.23, SD=4.79) (t(214) = 1.701, p=0.90). Similarly, there was no significant difference in WHR between individuals with PCOS (M=0.887, SD=0.65) and those without PCOS (M=0.882, SD=0.83) (t(214) = 0.473, p=0.637).

Conclusion: Our findings shows that most participants have elevated BMI and WHR. Despite observed trends, the lack of significant association between PCOS and anthropometric indices indicates that lifestyle, genetics, and hormonal factors may play a huge role in excessive body weight. Achieving optimal body weight through lifestyle changes in reproductive-age women is a cost-effective way to enhance fertility in low-middle-income countries.

Keywords: anthropometric indices, sub-fertility, PCOS, Sri Lanka

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[a] *Senior Lecturer, Department of Obstetrics and Gynecology, University of Jaffna, Sri Lanka*

[b] *Professor in Obstetrics and Gynecology, Department of Obstetrics and Gynecology, University of Jaffna, Sri Lanka*

[c] *Professor of Medicine and Chair, Department of Medicine, Faculty of Medicine, University of Jaffna, Sri Lanka*

[d] *Temporary Demonstrator, Faculty of Medicine, University of Jaffna, Sri Lanka*

[e] *Temporary Demonstrator, Faculty of Medicine, University of Jaffna, Sri Lanka*

Correspondence: SR, e-mail: sivalingarajahraguraman@gmail.com

https://orcid.org/0000-0001-7157-3680

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Introduction

The World Health Organization (WHO) identifies sub-fertility as a condition related to reproductive health. It defines sub-fertility as "failure to achieve pregnancy after 12 months or more of regular, unprotected sexual intercourse"[1-3]. This condition affects 17.5% (95% confidence interval: 15.0, 20.3) of individuals worldwide, and notably 16.5% in low-middle income countries[4]. Sub-fertility impacts the physical, psychological, and social aspects of couples, particularly in low-middle-income countries, resulting in social stigma and poor self-esteem[5].

Obesity is a rising global concern that is predicted to affect one billion people worldwide in 2022[6]. It influences fertility in women, and 6% of 'never-pregnant' women are struggling with fertility and obesity [7-9]. Obesity is characterised by excessive fat accumulation, which detrimentally affects fertility and its treatment outcomes in several aspects, such as ovulatory dysfunction, disturbance in implantation, recurrent miscarriage, and recurrent implantation failure in assisted reproduction[7-10].

Understanding the correlation between anthropometric indices and sub-fertility aids in identifying obesity-related fertility issues, fertility treatment outcomes and obstetric outcomes. Therefore, preconception optimisation of weight in reproductive-aged women would enhance the fertility outcomes. Thus, this study aims to assess the association between anthropometric indices and sub-fertility among women of northern Sri Lanka attending the sub-fertility outpatient clinic conducted by the Department of Obstetrics and Gynaecology in Teaching Hospital, Jaffna.

Methods

An institutional-based cross-sectional descriptive study was conducted among females aged 18 years and above who attended the Department of Obstetrics and Gynaecology's sub-fertility outpatient clinic in Teaching Hospital, Jaffna, from August 2023 to February 2024. Ethical clearance (Reference number S01-09-2023) was obtained from the Ethical Review Committee at Teaching Hospital Jaffna, and informed written consent was obtained from all participants prior to the data collection.

All female residents in the Northern province of Sri Lanka over the age of 18 years as well as having female factor sub-fertility and attend the Sub-Fertility Clinic at the Professorial Unit in Teaching Hospital, Jaffna were considered for the study. A convenient random sampling technique was employed, and 216 subfertile women were chosen. Women with acute or chronic surgical conditions, neurological or psychiatric illnesses and sub-fertility exclusively due to malefactor were excluded from this study.

An interview-administered questionnaire was used following bilingual translation and content validation to collect data, which consisted of 21 questions to assess the sociodemographic and sub-fertility factors. Participants' height (cm) was measured using a stadiometer in an upright stance, and weight (kg) was recorded using a standardised electronic weighing scale with a precision of 0.1 kg. Waist and hip measurements were taken using non-stretchable measuring tape at the umbilical and maximal gluteal positions, respectively, with a precision of 0.1 cm. Body Mass Index (BMI) was calculated as weight divided by height squared (kg/m^2). Waist-to-Height Ratio (WHR) was computed from waist and height measurements.

Data analysis was performed using SPSS Version 26. Both continuous and categorical variables were presented using descriptive statistics. A Chi-square test and Bivariate logistic regression analysis determined variables influencing anthropometric measures in sub-fertile women. According to Sri Lankan Obesity standards criteria[15] BMI was categorised as underweight (<18.5 kg/m^2), normal (18.5-22.9 kg/m^2), overweight (23-24.9 kg/m^2), pre-obese (25-29.9 kg/m^2), and obese (≥30 kg/m^2). WHR for Asian women was categorised as Excellent (<0.75), Good (0.75-0.79), Average (0.80-0.86), and Risk (>0.86)[15,16]. Statistical significance was set at $P<0.05$ for all analyses.

Results

The study encompassed 216 sub-fertile women, resulting in a comprehensive response rate of 100%. Sociodemographic characteristics of the participants. All participants were aged between 20 and 49 years, with a mean age of 33.7 years (SD=7.12). A considerable percentage (38.9%) were older than 35 years. They were all (100%) Sri Lankan Tamil, with the predominant religious affiliation of Hinduism (77.8%).

Regarding educational attainment, the majority (78.56%) had completed average-level secondary

education. Notably, 53.2% of the participants reported having a monthly family income below LKR 23,000, signifying financial constraints within a significant portion of the study population. Employment statistics revealed that a substantial proportion (75.5%) of the participants were unemployed (Table 1).

Table 1. Basic characteristics of the study population

Demographic variables	Subfertility Types			
	Primary n=156 (72.2%)	Secondary n=60 (27.8%)	P-Value	Odds ratio (95%CI)
Age (in years)				
< 35 years	104 (78.8%)	28 (21.2%)	Ref	2.29 (1.246-4.193)
> 35 years	52 (61.9%)	32 (38.1%)	0.008	
Place of residence				
Rural	113 (75.35%)	37 (24.7%)	0.126	0.61 (0.327-1.147)
Urban	43 (65.2%)	23 (34.8%)	Ref	
Religion				
Hindus	121 (72.0%)	47 (28.0%)	0.903	1.046 (0.509-2.149)
Christians	35 (72.9%)	13 (27.1%)	Ref	
Education				
Below Ordinary level	18 (64.3%)	10 (35.7%)	0.405	1.44 (0.611-3.389)
Ordinary level and above	101 (72.1%)	39 (27.9%)	Ref	
Occupation				
Unemployed	117 (71.8%)	46 (28.2%)	Ref	0.91 (0.454-1.838)
Employed	39 (73.6%)	14 (26.4%)	0.799	
Duration of Marriage				
<5 years	106 (86.2%)	17 (13.8%)	Ref	5.36 (2.787-10.318)
>5 years	50 (53.8%)	43 (46.2%)	<0.001	
Type of Marriage				
Consanguineous	32 (86.5%)	5 (13.5%)	0.40	2.84 (1.050-7.675)
Non-Consanguineous	124 (69.3%)	55 (30.7%)	Ref	
Family type				
Joint family	38 (71.1%)	22 (28.9%)	0.777	1.09 (0.588-2.033)
Nuclear family	102 (72.9%)	38 (63.3%)	Ref	
Family history of subfertility				
Yes	51 (86.4%)	8 (13.6%)	0.006	0.317 (0.140-0.716)
No	105 (66.9%)	52 (33.1%)	Ref	
Monthly income				
<23,000	81 (51.9%)	34 (56.7%)	0.532	1.211 (0.665-2.205)
>23,000	75 (48.1%)	26 (43.3%)	Ref	

Subfertility-related factors were identified within the participants

Among the 216 participants, 156 individuals (72.2%) had primary subfertility, whereas 60 participants (27.8%) had secondary subfertility. The duration of subfertility ranged from 1 to 22 years, with a calculated mean duration of 5.39 years (SD=3.96). Especially, a majority, about 56.9% of the study population, sought treatment for subfertility within the initial five years of their marriage. However, 43.1% did not pursue treatment during the same time frame.

In terms of aetiology associated with subfertility, a significant proportion (58.3%) of the study population was diagnosed with polycystic ovarian syndrome (PCOS), followed by tubal blockage affecting 11.1% of participants, and 6.9% presenting with endometriosis. Additionally, nearly half, precisely 48.6%, of the participants experienced irregular menstrual cycles.

Distribution of Anthropometric Indices Among Participants

Examination of BMI categories among the participants had varied distributions, with 70.3% of them falling into the overweight, pre-obese and obese categories. Underweight individuals accounted for 6.5% (n=14), and only 23.1% (n=50) were within the Normal BMI range. Among that, the highest proportion of participants, accounting for 37.0% (n=80), were within the pre-obese category. According to the Waist-to-Height Ratio (WHR), 2.8% of the participants (n=6) were cate-gorised as excellent, 1.4% (n=3) as good, and 29.2% (n=63) were as average. The majority of the partici-pants, accounting for 66.7% (n=144), were classified as at risk. These distributions provide valuable insights into BMI (Figure 1) and WHR categories (Table 2), illustrating the diverse health indices within our participant pool.

Table 2. Distribution of the WHR among study participants

WHR category	Frequency	Percentile
Excellent	6	2.8%
Good	3	1.4%
Average	63	29.2%
Risk	144	66.7%

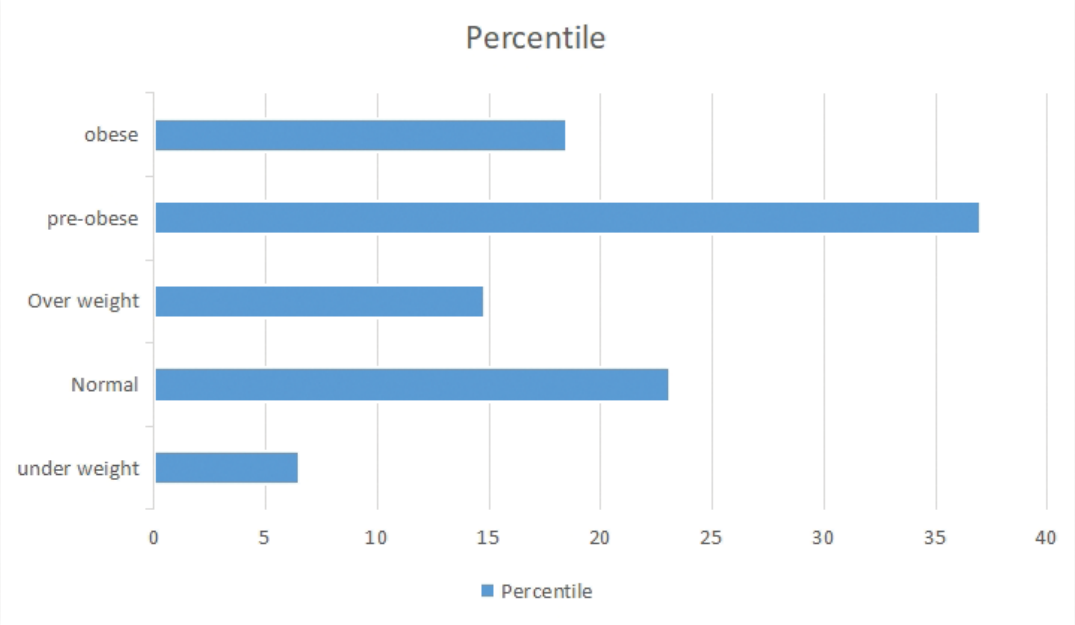

Figure 1. **Distribution of the BMI among the study population.**

Table 3. Distribution of Anthropometric measures among sub-fertility types

Anthropometric Indices	Primary sub-fertility (n=156)	Secondary sub-fertility (n=60)	P-Value
Weight	61.55±13.96	66.07 ±13.61	0.033
Height	155.28 ± 5.67	155.75±6.30	0.596
BMI	25.5 ± 5.4	27.1±4.7	0.041
Waist circumstances	8.61±11.1	86.13±10.3	0.001
Hip Circumstances	91.65±12.6	97.23±14.3	0.006
WHR	0.88±0.69	0.89±0.8131	0.410

Correlation of sociodemographic factors, Sub-fertility characteristics, and anthropometric indices with subfertility types

Our analysis highlighted significant relationship between demographic factors and subfertility types. A significant association was observed between subfertility types and age category (χ^2=7.294 df=1, P=0.007). Secondary subfertile (36.02 ± 7.11) women are older than those who are primary subfertile (32.88 ±6.95). These findings emphasise that age is an influential factor in understanding and managing subfertility in our study group.

The association between sub-fertility types (primary, secondary) and Anthropometric indices is given in detail in Table 3.

It shows notable differences between sub-fertility types (P<0.05) and reveals significant dif-ferences when comparing the average BMI, weight, waist circum-ference, and hip circumfer-ence. Height and WHR, however, did not show any significant differences.

Correlation of Anthropometric Indices with Polycystic ovarian syndrome

This study examined the association between anthropometric indices (BMI, WHR) and polycystic ovary syndrome (PCOS) within the subfertile population. Statistical analyses revealed no significant differences in BMI between individuals with PCOS (M=26.473, SD=5.58) and those without PCOS (M=25.23, SD=4.79) (t(214)=1.701, p=0.90). Similarly, there was no significant difference in WHR between individuals with PCOS (M=0.887, SD=0.65) and those without PCOS (M=0.882, SD=0.83) (t(214) = 0.473, p=0.637). These findings imply that within this subfertile population, PCOS may not have a notable impact on BMI or WHR within this.

Discussion

Our study assessed Anthropometric Indices among subfertile women and found out that a predominance of primary sub-fertility (72.2%) over secondary sub-fertility (27.8%). This finding is consistent with previous studies demonstrating a greater prevalence of primary sub-fertility compared to secondary sub-fertility[3,11,12].

Advancing age poses intricate challenges to female fertility due to reduced ovarian reserve, recurrent miscarriages, chromosomal abnormalities in embryos and pregnancy-related complications[13,14]. According to the American College of Obstetricians and Gynae-cologists (ACOG), a woman's reproductive peak occurs around 30, after which fertility gradually declines and further declines beyond 35 years[14]. Our study population exhibited a median age of 33 years (interquartile range: 11), with 38.9% of participants over 35 years old. It has shown the pattern of advanced maternal age in our clinical settings and underscores the timely pursuit of sub-fertility interventions in Northern Sri Lanka.

Adipose tissue plays a pivotal role in women's reproductive health by producing oestrogen, which is essential for the regulation of menstrual cycles and fertility[7,11]. However, obesity has a significant impact on public health as well as poses reproductive health challenges. Our study findings, which is adherence to Sri Lankan Obesity standards, revealed that only 23.1% (n=50) of women were categorised as having a normal weight. In contrast, majority of them (70.3%) fell into the overweight, pre-obese, and obese categories. This distribution deviates substantially from the findings reported by the National Nutrition and Micronutrient Survey conducted in 2022, indicating a 34.2% prevalence of overweight and obesity among females aged 18 to 60[15]. Moreover, the Sri Lanka Demographic and Health Survey conducted in 2016 reported an obesity prevalence of 8.9% among adult women aged 18 years and above[16]. These disparities suggest a substantial divergence in the prevalence of overweight and obesity among our study participants compared to the broader population statistics, emphasising potential distinct lifestyle patterns within this specific subgroup.

Further, majority (66.7%) of the participant's WHR fell within the high-risk group (WHR > 0.86), while 29.2% were classified as average (WHR > 0.8) and less than 5% of participants exhibited good or excellent WHR according to WHR classifications for Asian women. Notably, a WHR of more than 0.8 has consistently been linked with disruptions in menstrual regularity, ovulation, and reproductive health[17]. The association between higher WHR values and reduced probabilities of conception was pronounced. A high WHR was linked with noticeably reduced conception rate in a prospective cohort study of women seeking donor insemination and attending infertility clinics[18].

According to various studies PCOS significantly impacts reproductive-age women, with a prevalence ranging from 4% to 20%[19,20]. Our study reported that a majority (58.3%) of women were diagnosed with PCOS. Following that, tubal blockage affected 11.1% of participants, and 6.9% had endometriosis. These findings concur with a recent Sudanese study in which PCOS (51.6%) was predominated among infertile women, followed by tubal blockage (17.9%) and endometriosis (10.9%) [21]. A community-based study conducted in Sri Lanka reported PCOS prevalence as 5.9%[21]; however, as our study involved subfertile women in an institutional setting, the results were different. PCOS, tubal blockage and endometriosis are identified to be the most common aetiology of subfertility.

Numerous studies have reported strong correlation between PCOS and obesity, with a substantial percentage (38-88%) of individuals with PCOS being overweight or obese (22-24). Our study yielded contrasting results. No statistically significant association with PCOS was found between BMI (P = 0.053) and WHR (P = 0.461). Therefore, lifestyle factors might influence weight gain in subfertile women.

Conclusion

In this study, most participants' BMI and WHR are above the normal range. However, the absence of a significant association between PCOS and anthropometric indices, such as BMI and WHR, within our study population indicates that lifestyle patterns, genetic pool, and abnormal hormonal regulations than PCOS might influence excessive body weight. Therefore, adopting a healthier lifestyle modification could help achieve an optimal body weight, and enhance the fertility outcomes. Lifestyle modification in reproductive-age women is a cost-effective intervention to improve fertility in low- and middle-income countries.

Limitations

Despite the valuable insights gained, our study has notable limitations. A control population is necessary for a comparative analysis of our findings. Additionally, the need for detailed data on dietary patterns and physical activity history limits the comprehensive understanding of the relationships. There are particular changes in several factors, such as hormone fluctuations and lifestyle alterations (including lack of sleep, increased stress, and reduced physical activity) after the first pregnancy, which hinders thorough comprehension. Further investigations incorporating hormone level assessments, including thyroid stimulating hormones, oestrogen, and testosterone, would offer deeper insights into the correlations between subfertility types and obesity, addressing a significant gap in our study.

Abbreviations

WHO – World Health Organization, LMIC – low-middle income countries, ASRM – American Society for Reproductive Medicine, BMI – Body Mass Index, W.C. – Waist circumferences, H.C. – Hip circumferences, PCOs – Polycystic ovarian syndrome, and WHR – waist-to-hip ratio.

Conflicts of interests

The authors declare no conflict interests.

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Ethical Approval

The Ethics Review Board of Teaching Hospital Jaffna approved the present study with the following number: S01-09-2023.

Authors' Contribution

All authors were involved in conceptualisation. R.S., K.M., and K.T. provided expert guidance on questionnaire development and validation. R.S., K.M., and A.S. were involved in developing materials and methods. R.S. supervised the work locally and conversed with the leads K.M. and K.T. throughout data collection. T.K. and A.S. were involved with data collection and analysis. R.S. and A.S. led the writing of the manuscript, and all authors reviewed each draft.

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